

DEVELOPMENT AND PERFORMANCE EVALUATION OF PEDAL OPERATED MAIZE SHELLER

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ABSTRACT

Maize shelling or simply maize threshing is the most important aspect of post-harvest operation of maize. It involves detaching of the maize grain from its cobs. Now a days, few motorized, tractor/ power tiller operated machines have come into the market but the prices of these machines are not affordable to the peasant farmers. Some hand operated maize shellers have been developed but they shell only one cob at a time and have limitations to use it continuously for a longer period of time. Therefore, it was the aim of this investigation to develop and built a pedal operated maize sheller using locally available material so that the machine will be operated continuously for a longer period of time with high rate of shelling without causing damage to the kernels and evaluate the performance of pedal operated maize sheller in terms of capacity, shelling efficiency and visible damage. The machine dimensions are 144 cm × 80 cm × 145 cm.

The machine was tested on two local varieties of maize DHM117 and DHM115 with moisture content level below 12% (w.b.). The shelling capacity of pedal operated maize sheller on maize varieties DHM 117 and DHM 115 was found as 82.70kg/h and 83.53kg/h with an average shelling efficiency of 97.96% and 98.20% respectively. The capacity of this pedal operated maize sheller is 2 times higher than hand operated maize sheller.

KEYWORDS: Maize, Corn, Pedal Operated Maize Sheller, Machine Capacity & Shelling Efficiency

Received: Mar 13, 2017; **Accepted:** Mar 31, 2017; **Published:** Apr 10, 2017; **Paper Id.:** IJASRAPR201769

INTRODUCTION

Maize is one of the most important cereal crops in the world and contributes to food security in most of the developing countries. The botanical name of Maize is “Zea Mays” derived from Spanish word maiz. It is also known as corn. It has very high yield potential and is commonly known as “queen of cereals”.

Maize contains about 10% proteins, 4% oil, 70% carbohydrates, and 2 % crude fibre, 10 % albuminoides and 1.4% ash. Maize has significant quantities of vitamin A, nicotin acid, riboflavin and vitamin E. Over 85% of maize produced in the country is consumed as human food like chapattis prepared out of maize flour and grain, roasted ears and popcorn. Maize crop furnishes huge quantities of green fodder for cattle. Maize starch is used as chemical for production of plastics, fabrics and adhesives. Several industries like starch, milling etc., are based on maize products and by-products. In adding to big industries, several cottage industries are also flourishing on by-products of maize.

Maize processing not only prolongs its useful life but also increases the net profit farmers make from mechanization technologies. In Telangana the gross cropped area 58,67,826 ha in that the maize is cultivated over

the area of 5,10,026 ha. Telangana is contributing 8.7 % of maize in India. Medak district is contributing 16.4 % of maize in Telangana.

The present study carried out to develop a pedal operated maize Sheller which is typically a thresher for the small scale farmers who tend to maize farms less than two acres. For these farmers, the produce is approximately twenty sacks of maize in cobs per acre of cultivated farm.

MATERIALS AND METHODS

The Pedal operated maize sheller is simple in operation, consisting of following parts.

- Frame
- Circular toothed wheel
- Spring pressure plate
- Adjustment spring
- Cob outlet
- Shaft
- Seating arrangement
- Power transmission
- Collection Tray
- Outer cover.



Figure 1: Modified

- **Machine Frame**

The machine frame supports the parts of the maize sheller which provides balance and reducing vibrations of the maize sheller while in operation. The frame is made of M.S angular bars and the height of the frame is 740 mm, 750 mm length and 385mm wide. The frame is in rectangular shape. Four angular bars with 6 mm connected to the frame for

standing purpose. A handle is attached to the frame for the purpose of support to the operator while pedaling as shown in figure 1.



Figure 2: Machine Frame

- **Circular Toothed Wheel**

The circular toothed wheel is of 200 mm diameter and 10mm thickness. It is connected to the shaft and rotates along the rotation of the shaft. The circumference of the wheel is 157 mm as shown in figure 2.



Figure 3: Circular Toothed Wheel

The circular toothed wheel is used to shell the grains with shearing and impact force when the maize cob is fed against circular toothed plate while in rotation. The impact force is acted by the adjustment spring which presses the maize cob against the circular toothed wheel. The circular toothed plate takes 9 rotations to shell off one maize cob.

- **Spring Pressure Plate**

The main purpose of spring pressure plate is to compress the cob against rotating wheel. It is made up of 10 gauge metal sheet. It was made of MS (Mild Steel) angles and C channels as shown in figure 3. The upper body of the spring pressure plate is in the semi-circular shape and at the bottom it is extended, in the arrow shaped sheet. The dimension of the maize sheller spring pressure plate length is 236 mm, width is 166 mm, height is 42.5 mm. Arrow-shaped plate dimensions of the spring pressure plate length is 112 mm, width is 3.85 mm, and height is 0.8 mm.

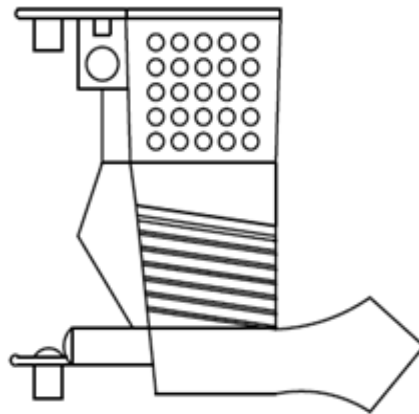


Figure 4: Spring Pressure Plate

- **Adjustment Spring**

Adjustment spring acts as a flexible joint between two parts or bodies. The objectives of adjustment spring are to cushion, absorb, or controlling of energy arising due to shock and vibration. It is also used for control of motion, storing of energy and for the purpose of measuring forces.

- **Cob Outlet**

The cob outlet is used to force the shelled cobs from rotating wheel to outlet at the end. The shelled kernels are detached from cobs and collected at the collection tray. It is fixed to the frame with help of screws. It is made up of M.S sheet of 10 gauge. Shear cutting machine is used to cut the M.S of required dimensions and it is bended in the middle with bending machine in oval shape. It is used to guide the shelled cobs to exit from the outlet after being shelled. It is shown in figure 4.



Figure 5: Cob Outlet

Shaft

Shaft is made up of mild steel. It is 315mm long and 30 mm diameter. In this machine one end of the shaft is connected power transmission unit and other end is connected to a toothed circular plate. The shaft rotates the toothed circular plate with rotation of sprocket with pedalling effect.

Seating Arrangement

A simple cycle seat is used for seating of the operator. The seat is fixed on the frame of the cycle. The cycle frame made up of MI hollow pipes. It consists of a sprocket (diameter 220 mm) with pedal arrangement as shown in figure 5.

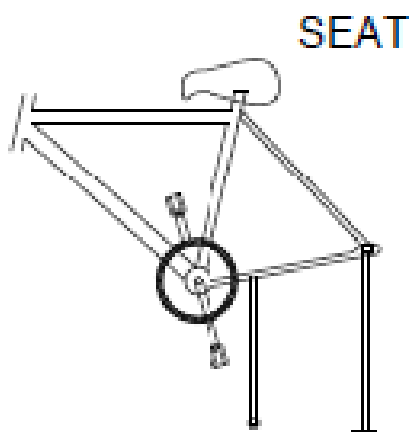


Figure 6: Line Diagram of Seating Arrangement

Power Transmission Unit

The simple cycle chain drive mechanism was used for transmission of power. The bigger sprocket (diameter 220 mm) connected with the two pedals acted as driver and drives smaller sprocket (diameter 80 mm) was mounted on the 30 mm diameter shafts of the shelling unit. The power transmission ratio of driver and driven sprocket is 1:3.

Collection Tray

Collection tray is fixed below the maize shelling unit, which acted as collection tray fixed to the frame. Its purpose is to collect the shelled maize grains from the machine.

Outer Cover

It was made up of 10 gauge G.I sheet. It is fixed to give protection to the shelling unit and to avoid grains spilling out.



Figure 7: Pedal Operated Maize Sheller

EVALUATION OF PEDAL OPERATED MAIZE SHELLER

The operators were given the tips, information and working of the machine for 20 min before starting the actual trials. In each trial machine was operated for 30 min to shell the maize cobs. Three trials of the machine were conducted on DHM 117 variety maize cobs with moisture content of 11.80% (w.b) and DHM 115 variety maize cobs with moisture content of 11.10% (w.b). The definitions and calculations of these parameters are as under

Shelling Capacity

The weight of maize cobs were shelled in unit time is calculates as shelling capacity of the machine

Shelling Efficiency

- Percentage by weight of shelled grains from all outlets of the sheller with respect to total grain input and it is calculated by the following formula.

$$\text{Shelling Efficiency (\%)} = \frac{(\text{quantity of shelled grain obtained from all outlets in kg})}{\text{Total grain input in kg}} \times 100$$

Unshelling Efficiency

- Unshelled grain from all outlets with respect to total grain input and it is calculated by the following formula.

$$\text{Unshelling efficiency (\%)} = \frac{(\text{quantity of unshelled grain obtained from all outlets in kg})}{\text{Total grain output in kg}} \times 100$$

Visible Damage (%)

- Visible damage grains from the grain outlet with respect to total grain received at outlet expressed as percentage by weight.

$$\text{Visible damage (\%)} = \frac{(\text{Broken grains from outlet in kg})}{\text{Total grain input in kg}} \times 100$$

RESULTS AND DISCUSSIONS

The Pedal operated maize Sheller was initially tested on DHM 117 variety maize cobs for 30 minutes and five trails were recorded. The shelling capacity in terms of maize cobs varied from 75.63 kg /hr to 88.66 kg /hr with an average of 82.704 kg/hr as shown in table 1, whereas hand operated maize sheller shelling capacity is 40 kg/hr

Table 1: Performance of Pedal Operated Maize Sheller on DHM 117 Variety

Replications	Time, min	Weight of cobs, kg	Capacity, kg/h	Shelling Efficiency, %	Unshelled grains, %	Visible damage, %
1	30	44.330	88.660	97.300	2.300	0.578
2	30	42.755	85.510	97.800	1.962	0.574
3	30	41.860	83.720	98.100	1.730	0.662
4	30	40.000	80.000	98.220	1.573	0.708
5	30	37.815	75.630	98.420	1.462	0.725
Average	30	41.352	82.704	97.960	1.805	0.649

The pedal operated maize sheller was tested on DHM 115 maize variety. The shelling capacity in terms of maize cobs varied from 76.27 kg/hr to 90 kg/hr with an average of 83.53 kg/hr as shown in table 2.

Table 2: Performance of Pedal Operated Maize Sheller on DHM 115 Variety

Replications	Time, Min	Weight of Cobs, Kg	Capacity, Kg/H	Shelling Efficiency, %	Unshelled Grains, %	Visible Damage, %
1	30	45.000	90.000	97.700	2.035	0.402
2	30	43.060	86.120	98.120	1.559	0.205
3	30	42.550	85.100	98.230	1.487	0.122
4	30	40.085	80.170	98.300	1.285	0.162
5	30	38.135	76.270	99.620	0.630	1.306
Average	30	41.765	83.530	98.280	1.299	0.439

The shelling rate per hour is 2.0 times higher than hand operated maize sheller in case of pedal operated maize sheller with operator mainly due to less effort requirement to operate the machine by legs which increased the speed of operation of machine.

CONCLUSIONS

The pedal operated maize sheller was tested on two maize varieties and gave an output of 80 kg/h where as an capacity of Hand operated maize sheller capacity was founded to be 40 kg/h. It is mainly used for small and marginal farmers. It is very cheap in cost compare to other manual operated maize sheller and the cost of machine is Rs. 5,500/-. The average shelling efficiency of machine is 98%.

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